PATENT SPECIFICATION

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Complete Specification Left: March 6, 1944.

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PROVISIONAL SPECIFICATION

Improvements in or relating to Fuel Injection Devices for Internal Combustion Engines

We, DAVEY PAXMAN & COMPANY LIMITED, a British Company, and EDWARD PHILIP PAXMAN, a British Subject, both of Standard Ironworks, Colchester, Essex, do hereby declare the nature of this invention to be as follows:—

This invention relates to internal combustion engines of the compression-ignition type and has for its object to provide an improved form of valve device applicable to a fuel injector nozzle and designed to enable the construction and manufacture of such nozzle to be considerably simplified.

According to the invention the valve component of a fuel injector nozzle for an internal combustion engine comprises a non-metallic compressible body capable of being initially set so that it is lifted off its seat by the pressure of the fuel being injected.

In carrying the invention into effect and according to the preferred form thereof, a fuel injector nozzle for an internal combustion engine is provided with an inlet valve element which is made in a plastic or other resilient material capable of being compressed but possessing also a degree of recovery which will enable it to act as a spring. This valve element is of cylindrical form having a substantially conical tip at its end nearer the combustion chamber formed of a heat resisting hard steel. The opposite end of the valve element is of enlarged diameter to form an annular shoulder which abuts against the outer end of the cylindrical steel nozzle which encloses that portion of the valve element of smaller diameter. The outer end of the valve element has a central passage communicating with radial ports situated slightly in advance of the said annular shoulder and communicating with an annular passage formed between the valve element and the steel nozzle which has a central aperture at its inner end forming a valve seat in which the steel tip of the valve element engages.

The valve element is held in position by its aforesaid annular shoulder engaging the end of the steel nozzle in which position it is held by the end of the inlet pipe nipple. This mounting of the valve element enables it to be initially compressed to such a degree that it exerts a pressure on the valve seat at the inner end of the nozzle equal to the pressure at which the valve should lift during operation. If, for example, it is intended that the valve should open at a pressure of 1500 lbs. per square inch, the valve element should be compressed so that it exerts a force on its seating equal to that which would be created by a reverse pressure due to the incoming fuel delivered by the pump and acting on the inner end of the valve element. It is thus necessary for the valve element to be capable of being compressed still further to open and allow fuel to enter the combustion chamber.

The valve element together with the nozzle is preferably mounted within a protecting holder or sleeve of substantially cylindrical form which may be screw-threaded at its forward end to enable it to be screwed into a cylinder head in a manner similar to a sparking plug. Alternatively, the forward end of the said holder may be of plain cylindrical form with a notched or perforated flange through which bolts can be passed to engage the cylinder head and retain the injector nozzle in operative position. The exterior of the protecting sleeve or holder may also be formed with cooling fins.

The device above described may be employed in conjunction with a perforated circular or cylindrical element formed of a heat resisting material and adapted to be interposed between the inner end of the nozzle and the combustion chamber to screen the face of the nozzle from the effects of combustion and of the gases resulting therefrom. Between the inner end of the nozzle and the end of the protecting sleeve or the said perforated element, there is disposed a heat insulating washer.

By employing a valve element made in a plastic or other compressible material,

the invention enables manufacture to be considerably cheapened and is especially applicable to small engines as it eliminates the use of a spring and complex port arrangements frequently found in nozzles of the kind described. The construction also eliminates the necessity for a drain-pipe and the fuel delivery connection is made coaxial with the nozzle.

Dated this 22nd day of April, 1943.

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COMPLETE SPECIFICATION

Improvements in or relating to Fuel Injection Devices for Internal Combustion Engines

We, DAVEY PAXMAN & COMPANY LIMITED, a British Company, and EDWARD PHILIP PAXMAN, a British Subject, both of Standard Ironworks, Colchester, Essex, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to fuel injection devices and while having more particular reference to the fuel injection devices of certain types of internal combustion engines is also applicable to injection devices of the kind used in boiler and other furnaces.

The object of the invention is to provide an improved form of valve device applicable to a fuel injector nozzle which is designed to enable the construction and manufacture of such nozzles to be considerably simplified.

According to the invention the improved fuel injection device comprises a casing, means for securing said casing in position adjacent a combustion chamber or the like, a valve component in said casing formed of a compressible plastic material adapted to engage a fixed valve seating and to open under pressure due to the incoming fuel and means for setting the pressure at which said valve will open.

Reference will now be made to the accompanying drawings in which:—

Fig. 1 is a sectional elevation showing one form of the improved fuel injector nozzle, and

Fig. 2 is a sectional elevation of an alternative form of construction.

Referring first to Fig. 1, a fuel injector nozzle for an internal combustion engine comprises a protective casing or sleeve *a* of substantially cylindrical form which is screw threaded at its forward end *b* to enable it to be mounted in a cylinder head *c* in a manner similar to a sparking plug. Within the casing *a* is mounted an inlet valve element *d* which is made of a resilient material such as a plastic material of a character capable of being compressed but possessing also a degree of recovery which enables it to act in a manner similar to a spring. A suitable material for the purpose is a member of the phenol-formaldehyde group. The valve element *d* is of cylindrical form having a substantially conical tip *e* at its end nearer the combustion chamber *f*, this tip being formed of a heat-resistance hardened steel and being secured to the valve element by means of a rearwardly extending shank *e*¹ fitted into a cylindrical socket in the valve element.

The outer end of the valve element is of enlarged diameter at *g* to form an annular shoulder *h* which abuts an annular shoulder *i* formed within the casing *a*. The outer end of the valve element has a central passage *j* communicating with radial ports *k* situated slightly in advance of the annular shoulder *h* and communicating with an annular passage *l* formed between the valve element *d* and the inner wall of the casing *a*. The casing *a* has a central aperture *m* at its inner end forming a valve seat in which the steel tip *e* of the valve element engages, being held in this position with its annular shoulder *h* engaging the shoulder *i* by the flanged end *n* of an inlet pipe *o*. This mounting of the valve element enables it to be initially compressed to such a degree that it exerts pressure on the valve seat *m* equal to the pressure at which the valve should open during operation.

The delivery pipe *o* is enabled by the construction above described to enter the device in a position co-axial with the nozzle and this pipe is secured in position by a nut *q* which engages a screw threaded socket in the casing member *a* which may be provided externally with a hexagonal portion *p* to facilitate its mounting in the cylinder head *c*. The inner end of the nut *q* bears against the flanged end *n* of the inlet pipe and the pressure necessary to seat the member *e* on the valve seat *m* is obtained by screwing in the nut *q*. If, for example, it is intended that the valve should open at a

pressure of 1500 lbs. per square inch, the valve element *d* should be compressed so that it exerts a force on the valve seat *m* equal to that which would be created by a reverse pressure due to the fuel delivered by the pump, acting on the portion *e* of the valve member. The element *d* must, therefore, be capable of being compressed still further as the valve element *e* is being lifted.

The construction above described may be modified by eliminating the screw threading *b* on the casing *a* and by replacing the hexagonal portion *p* by a notched or perforated flange through which pass bolts to engage the cylinder head and retain the injector nozzle in operative position.

In the alternative construction shown in Fig. 2, the interior of the fuel injector is constructed and arranged in the same manner as already described with reference to Fig. 1 and the component parts are indicated by the same reference letters, but the casing *a*, in this instance also contains a cylindrical steel nozzle *r* which provides at its inner end the valve seating *m* and at its outer end bears against the shoulder *h* on the valve member. In this form of the invention the casing *a* is formed with cooling fins *s* which may be of hexagonal form to facilitate screwing of the casing *a* into the operative position shown.

For the purpose of making a joint between casing *a* and the cylinder head *c* capable of resisting the pressure of the gases in the combustion chamber, it is preferred to employ a washer, which may be of copper, indicated at *v* in Figs. 1 and 2, which is interposed between the inner end of the nozzle and the end of the recess in which it is mounted. In Fig. 2 there is also shown a protective button *t* formed of a heat-resisting material as described in our concurrent application No. 6488/43 (Serial No. 563,163), to screen the face of the nozzle from the effects of combustion and the gases resulting therefrom.

By employing a valve element made in a compressible plastic material, the invention enables manufacture to be considerably cheapened and is especially applicable to small engines as it eliminates the use of a spring and complex port arrangements frequently found in nozzles of the kind described. The construction also eliminates the necessity for a drainpipe and the fuel delivery connection is made coaxial with the nozzle.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A fuel injection device comprising a casing, means for securing said casing in position adjacent a combustion chamber or the like, a valve component in said casing formed of a compressible plastic material adapted to engage a fixed valve seating and to open under pressure due to the incoming fuel and means for setting the pressure at which said valve will open.

2. A fuel injection device according to Claim 1 wherein the said valve component comprises a substantially cylindrical element of compressible plastic material having a conical metallic end adapted to engage a valve seating formed centrally in the end of a cylindrical casing or nozzle under the operation of a securing nut screwed into the outer end of the casing.

3. A fuel injection device according to Claim 2 wherein the fuel delivery pipe is mounted in axial alignment with the valve component and valve seating and terminates in an inlet which bears against the outer end of the said valve component under the action of the securing nut through which the delivery pipe passes.

4. A fuel injection device according to Claim 2 wherein the said valve component has an outer portion of enlarged diameter adapted to engage the outer end of a nozzle casing or sleeve, the said valve component having an axial inlet passage and radial ports through which the fuel reaches an annular passage around the valve component and leading to the valve seating.

5. A fuel injection device for an internal combustion engine of the compression-ignition type comprising a casing, a valve seating formed centrally at the inner end of said casing, a valve component mounted within said nozzle and comprising a substantially cylindrical member of compressible plastic material, a conical tip carried by the inner end of said valve component and adapted to engage said seating, a fuel delivery pipe secured into said casing in axial alignment with said valve component, a central inlet passage and radial ports in said valve component through which fuel passes from said delivery pipe through an annular passage surrounding said valve component to said valve seating and means for exerting pressure on the outer end of said valve component.

6. A fuel injection device constructed, arranged and adapted to operate as herein described with reference to Fig. 1 or Fig. 2 of the accompanying drawings.

Dated this 6th day of March, 1944.

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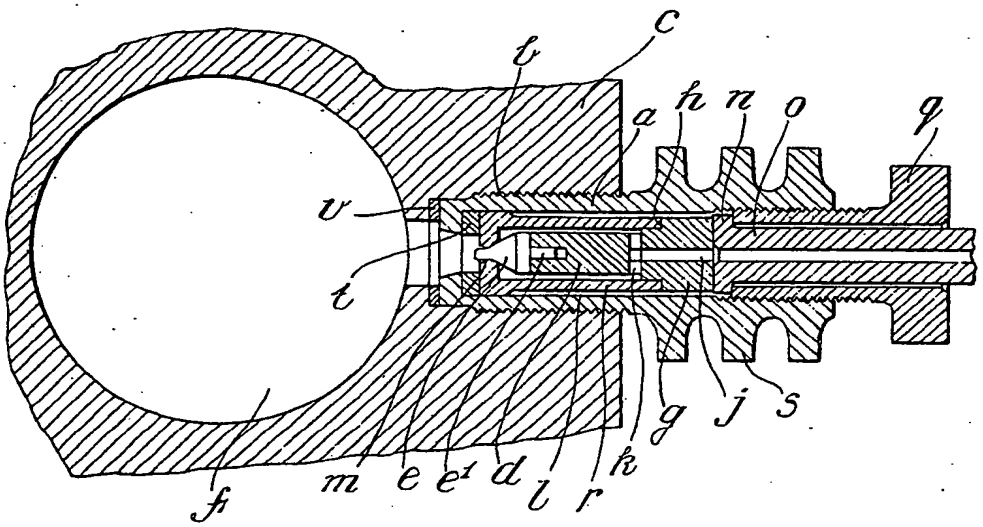

Fig. 2.

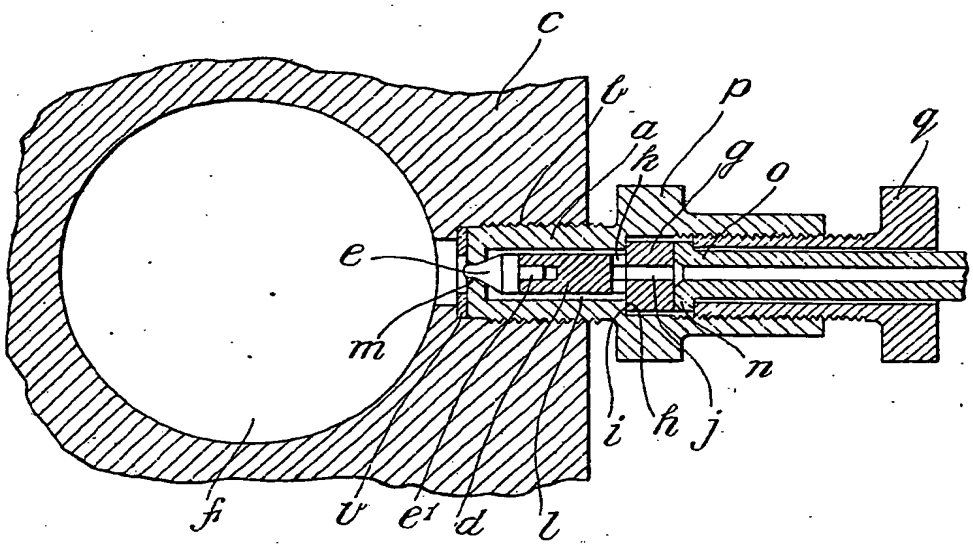

Fig. 1.

Malby & Sons, Photo-Lith.